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Lee

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(54) **APPARATUS AND METHOD FOR MANUFACTURING COMPRESSED LUMP OF METAL SCRAP**

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(73) Assignee: **DAEJONG INDUSTRY CO., LTD.**, Gyeonggi-Do (KR)

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B30B 1/00 (2006.01)
B30B 9/30 (2006.01)

(52) **U.S. Cl.**
CPC ***B30B 9/327*** (2013.01); ***B30B 9/3014*** (2013.01); ***B30B 9/3078*** (2013.01); ***B30B 9/32*** (2013.01)

(58) **Field of Classification Search**
CPC B30B 9/3078; B30B 9/326; B30B 9/327; B30B 9/328; B30B 9/3014; B30B 9/32; Y10S 100/906; C22B 1/248; B21J 5/08; B21J 5/10
USPC ..... 100/94, 95, 98 R, 98 A, 218, 232, 229 R, 100/240, 245, 246, 247, 255, 295, 901, 100/906; 29/403.2, 422; 425/406; 72/362, 72/370.27, 333; 75/770
See application file for complete search history.

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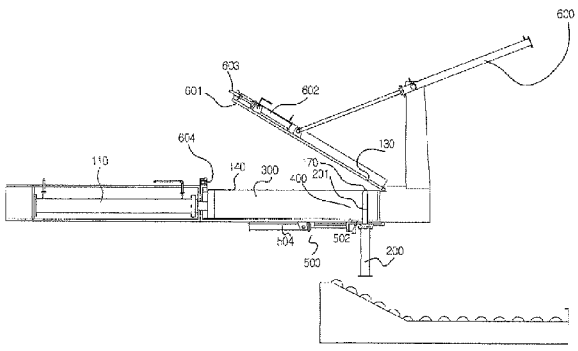
(57) **ABSTRACT**

An apparatus and method for manufacturing a compressed lump of metal scrap that is capable of compressing various kinds of collected metal scrap into a standardized form so that the metal scrap can be directly introduced into a blast furnace. A through hole is formed in a compressed lump of metal scrap during manufacture of the compressed lump of metal scrap so that the compressed lump of metal scrap can be efficiently melted and the interior of the compressed lump of metal scrap can be observed.

17 Claims, 13 Drawing Sheets



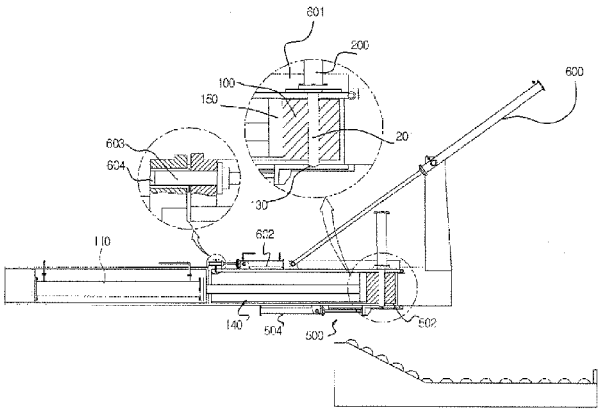
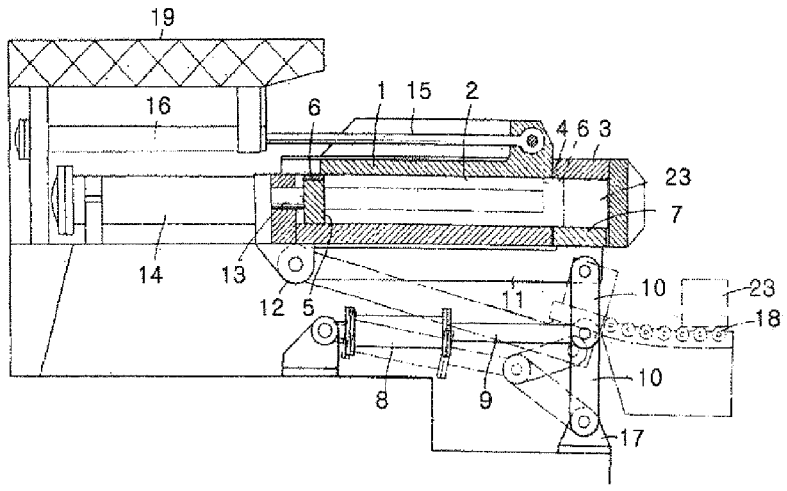
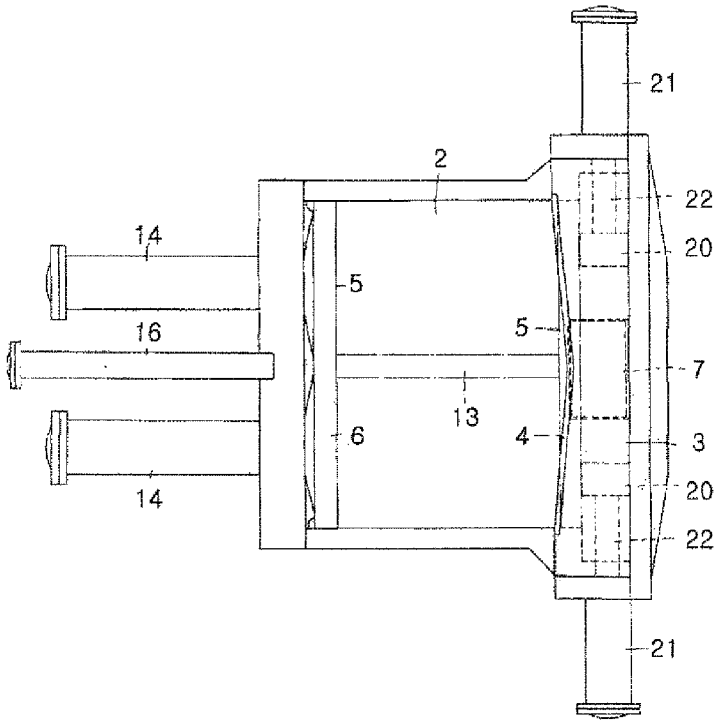


FIG. 1



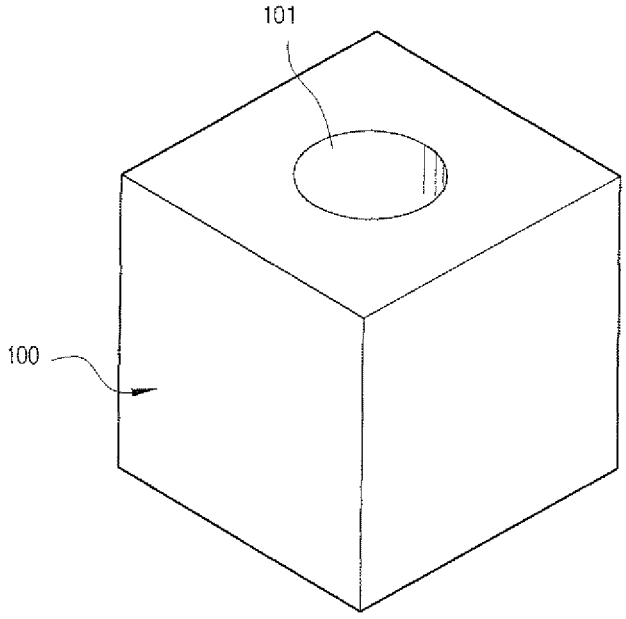
PRIOR ART

FIG. 2



PRIOR ART

FIG. 3



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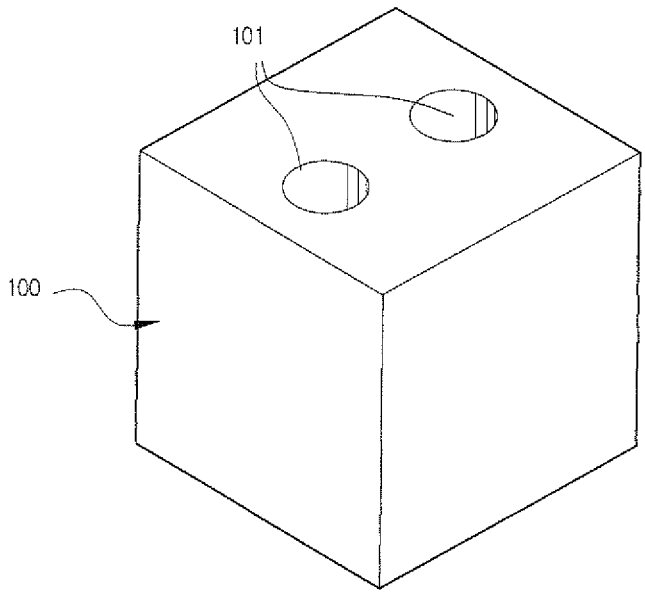

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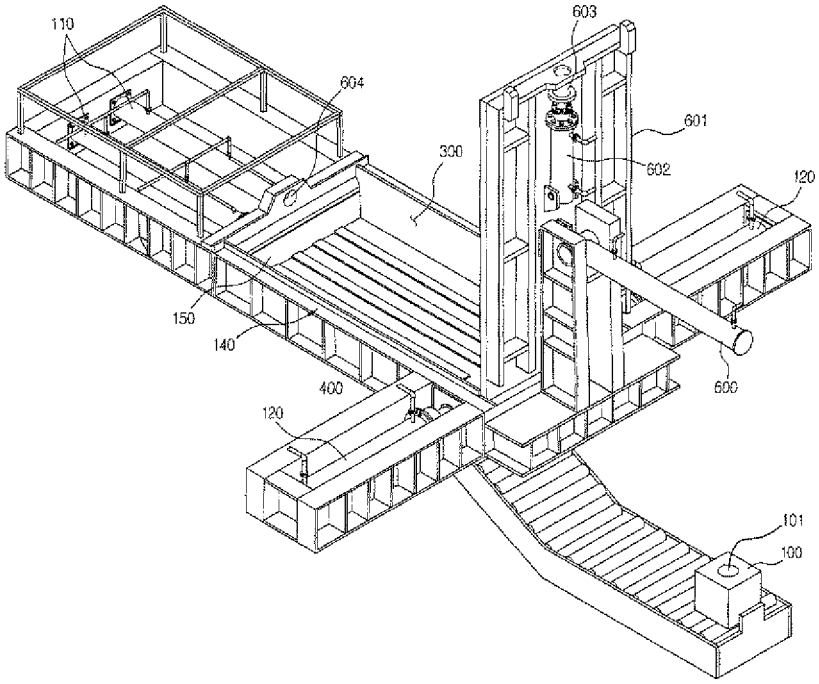
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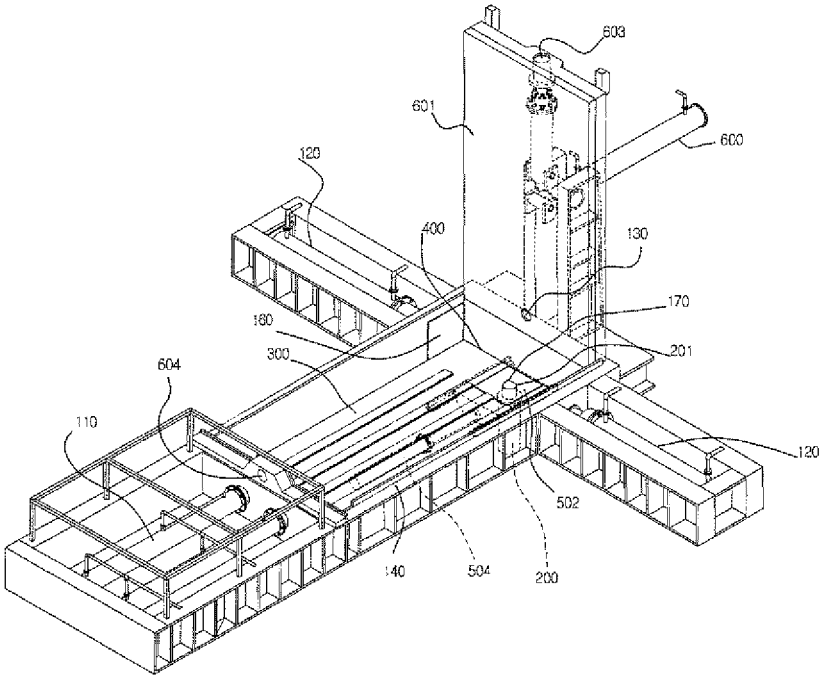
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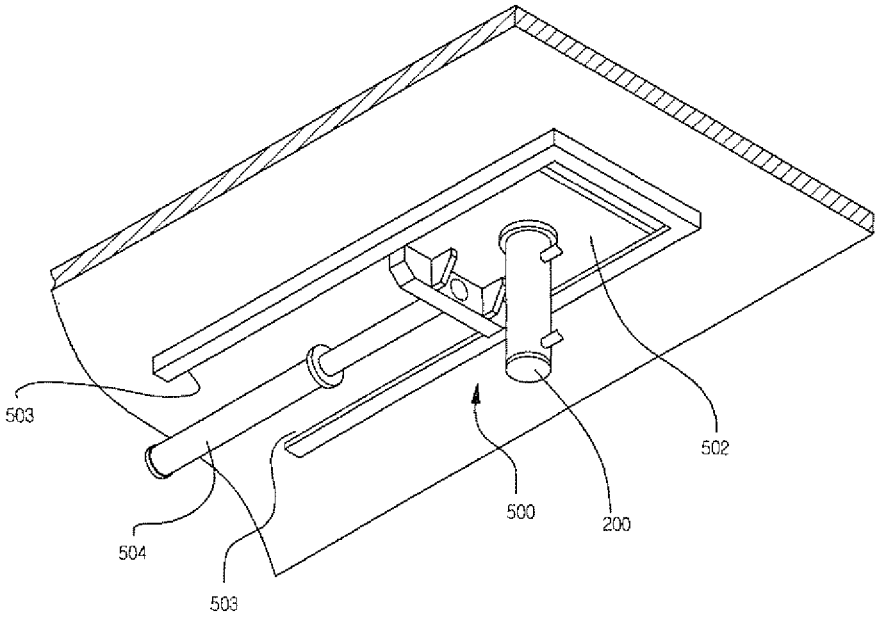
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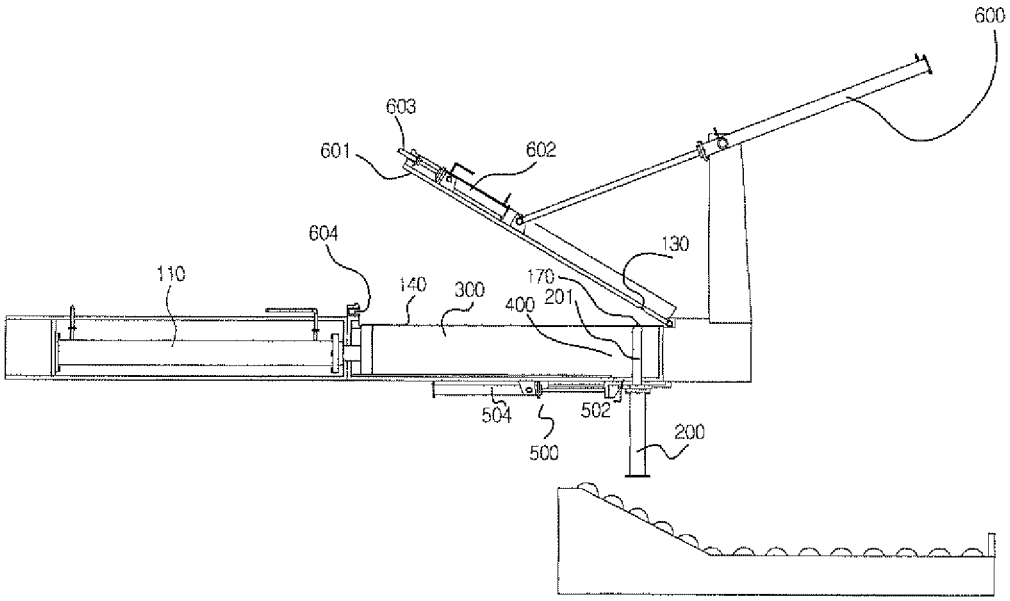
FIG. 8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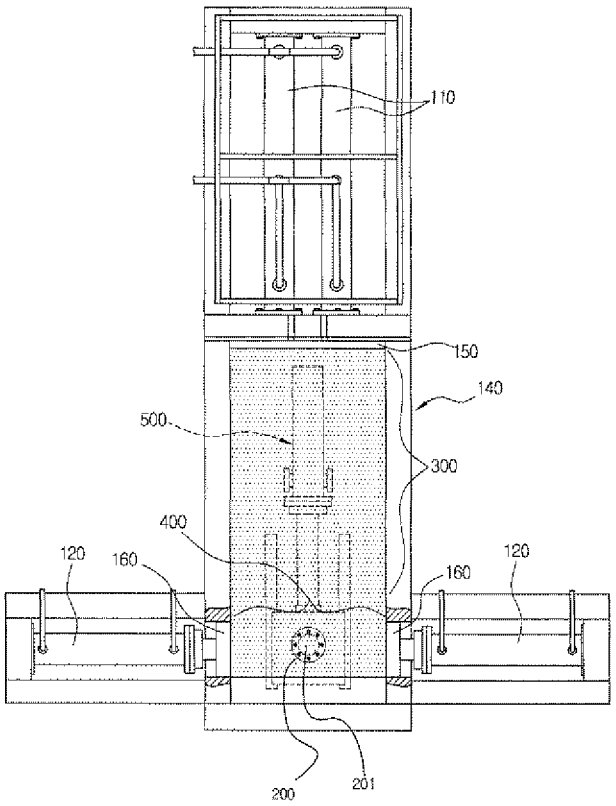
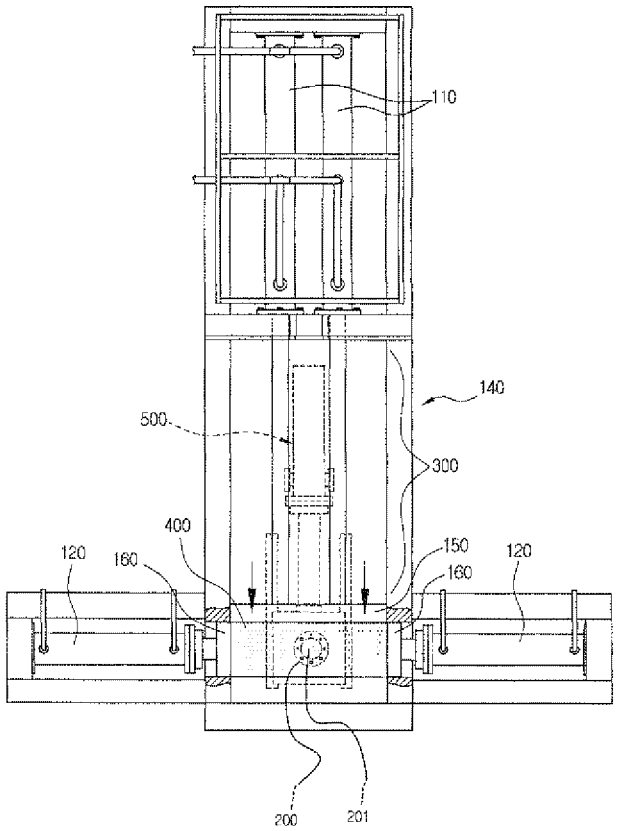


FIG. 10



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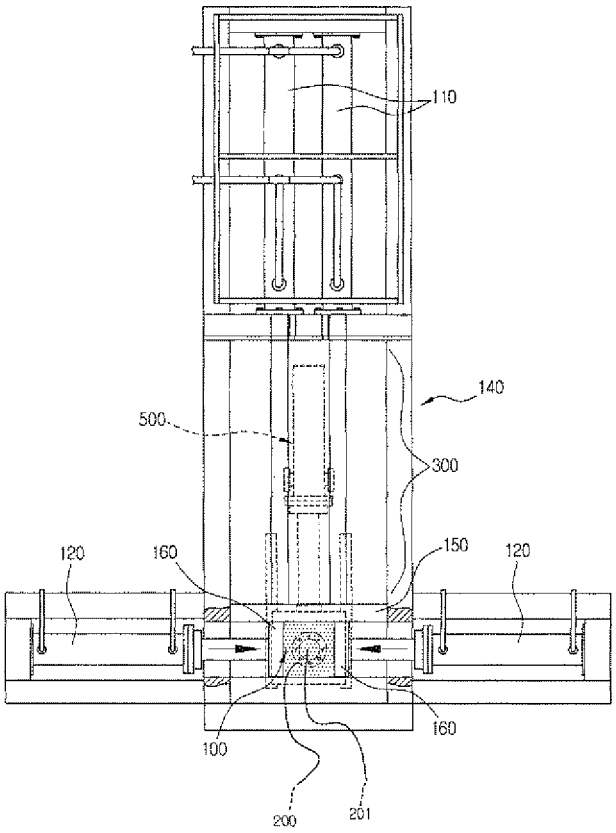
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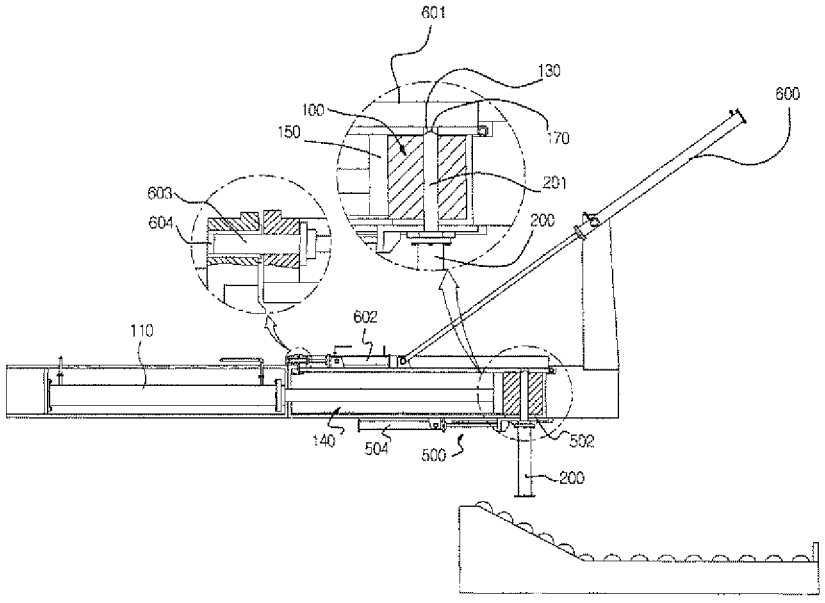
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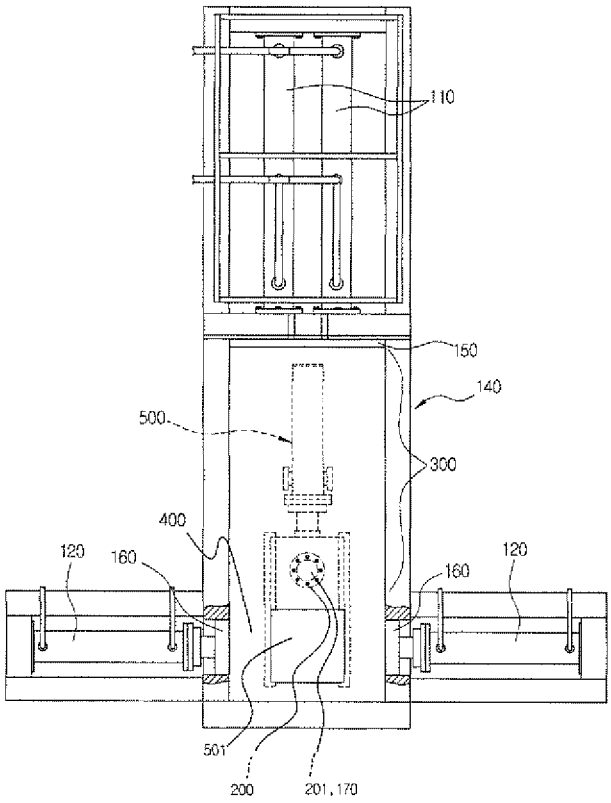
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FIG. 14

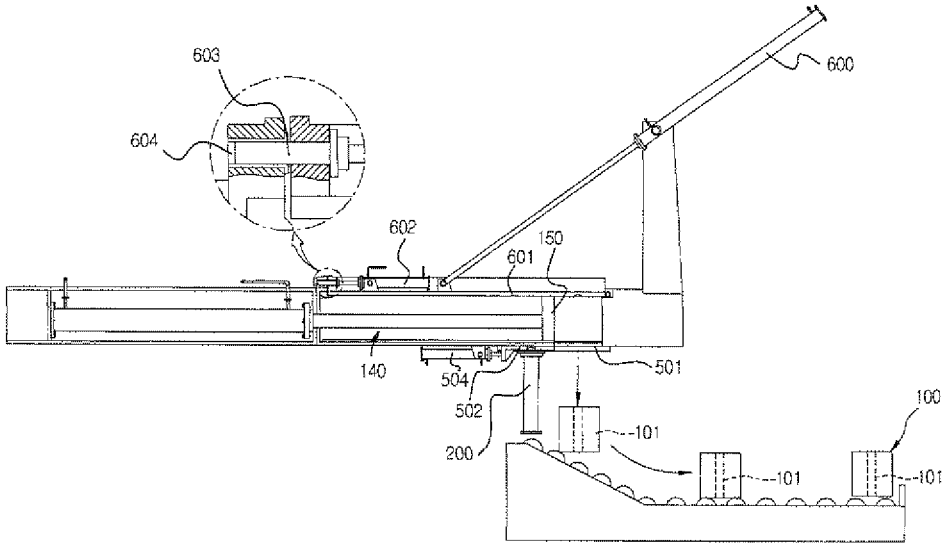
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FIG. 15

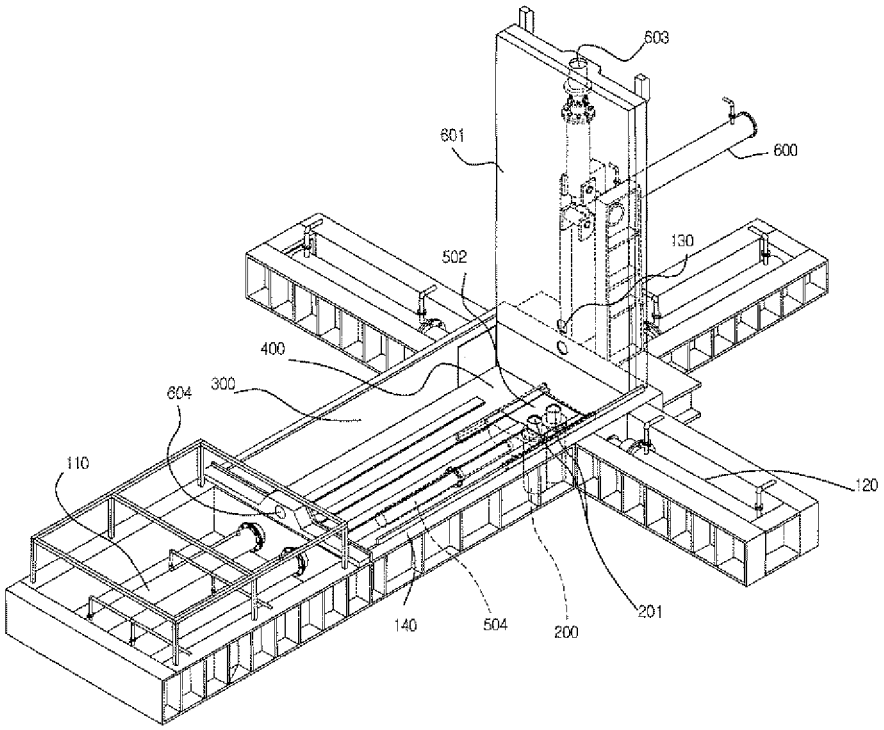
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FIG. 16

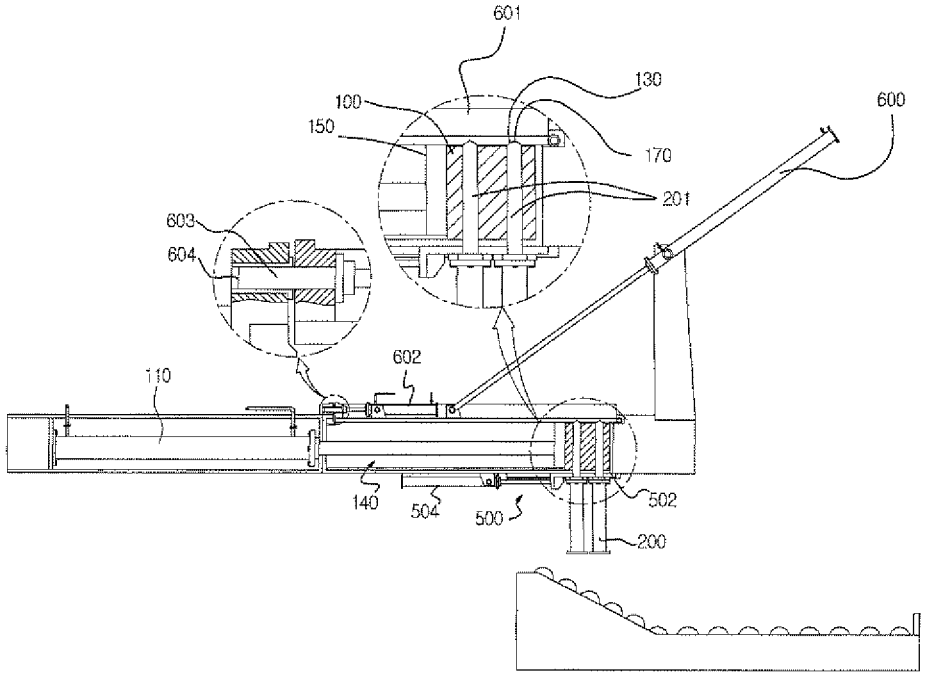
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FIG. 17

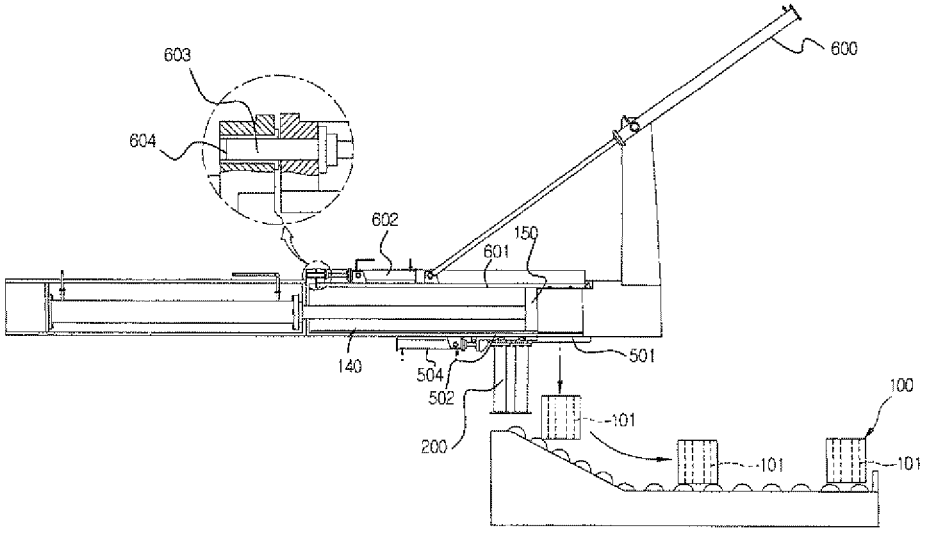
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FIG. 18

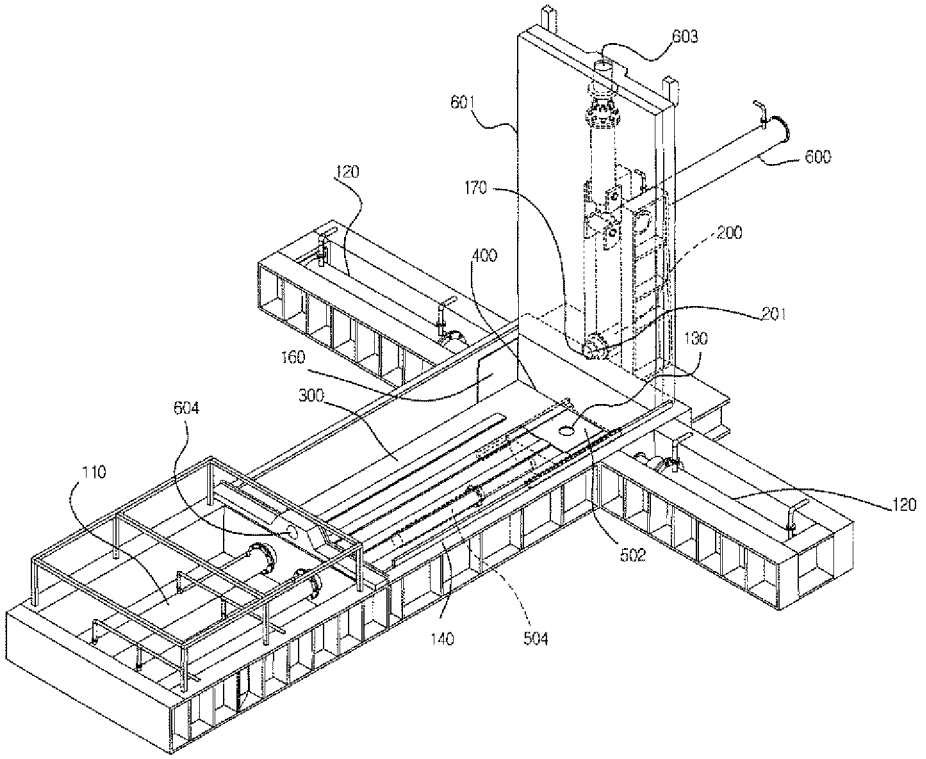
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FIG. 19

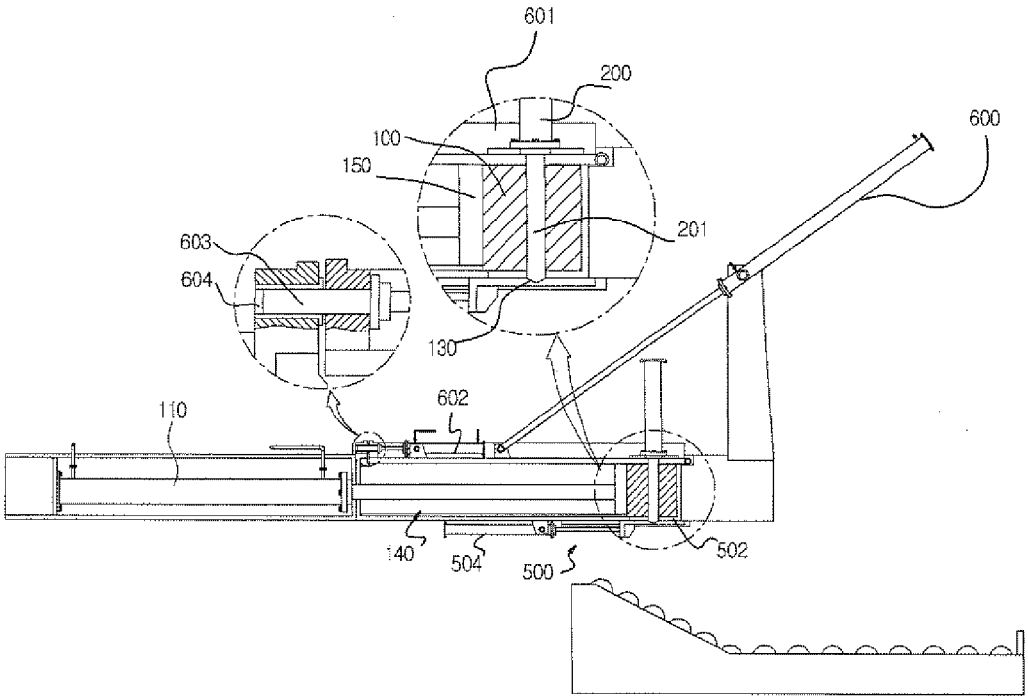
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FIG. 20

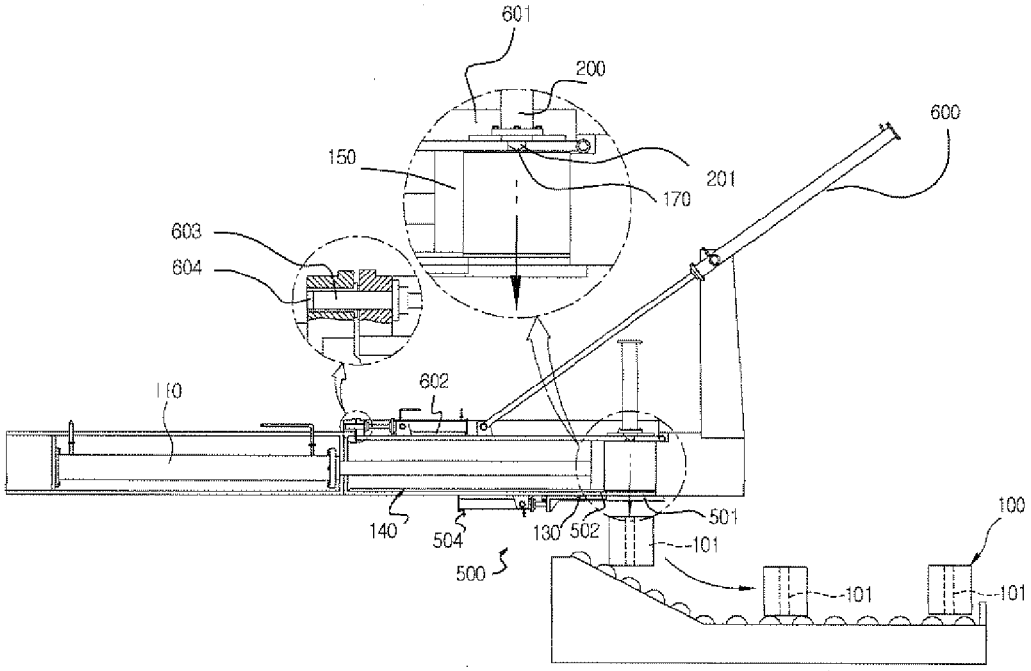
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FIG. 21

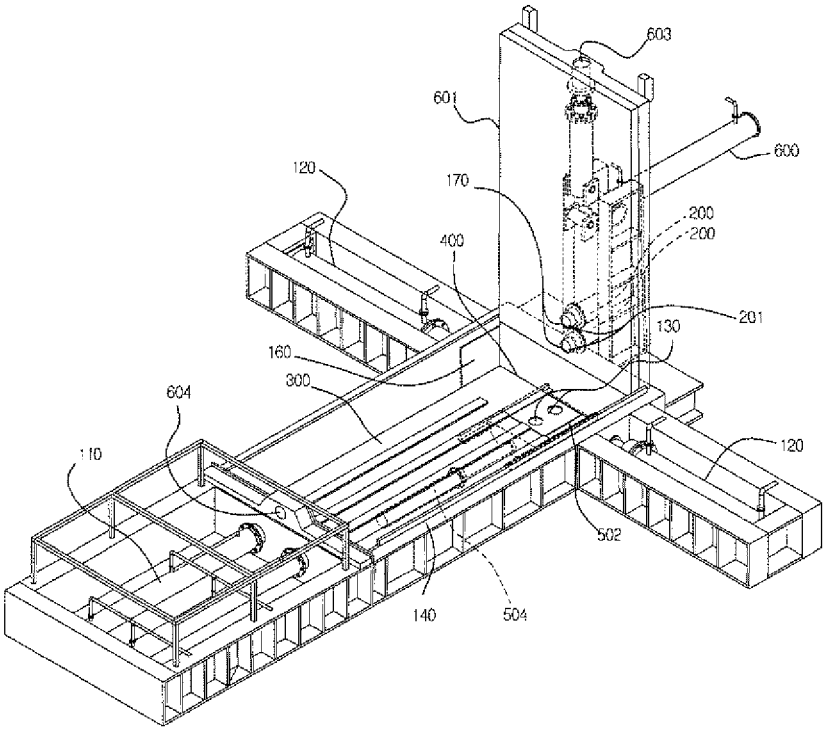
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FIG. 22

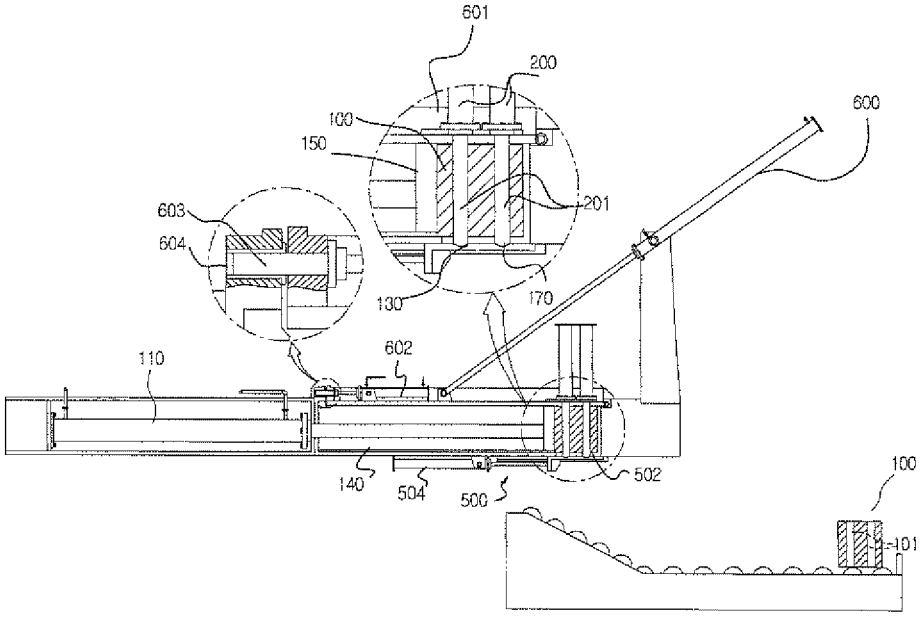
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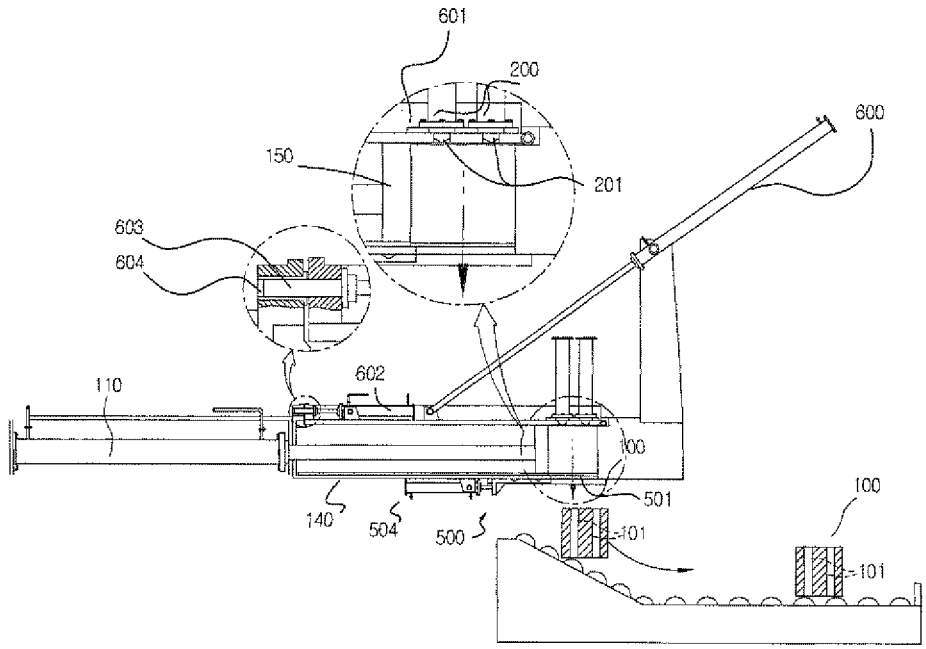
FIG. 23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APPARATUS AND METHOD FOR MANUFACTURING COMPRESSED LUMP OF METAL SCRAP

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to international patent application number PCT/KR2012/000657, entitled, "Apparatus for Manufacturing Metal Scrap Compression Material and Manufacturing Method thereof", filed on Jan. 30, 2012, and Korean Patent Application Number 10-2011-008561, filed on Jan. 28, 2011 the entire disclosures of which are hereby incorporated herein by reference in their entireties for all purposes.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus and method for manufacturing a compressed lump of metal scrap that is capable of compressing various kinds of collected metal scrap into a standardized form so that the metal scrap can be directly introduced into a blast furnace.

2. Description of the Related Art

As is generally known, various kinds of metal scrap, including materials dug from various production fields or used molds disposed from various production fields, reinforcing rods obtained from demolished buildings, and metal waste, such as scrapped vehicles, disused gas containers or cans obtained from various consumption fields, are collected, sorted, and melted to manufacture various kinds of steel materials, thereby reducing resources and energy used to manufacture steel materials and eventually protecting environment.

To this end, metal scrap is basically sorted according to kinds of the metal scrap and is compressed into a compressed lump of metal scrap which is formed and standardized so that the compressed lump of metal scrap can be directly introduced into a blast furnace of a steel mill, to which the compressed lump of metal scrap is supplied.

Such a compressed lump of metal scrap is generally configured so that the sum of the width, length, and height of the compressed lump of metal scrap is between 600 mm and 2100 mm. Also, metal scrap is compressed so that a compressed lump of metal scrap has the maximum length of less than 800 mm and a density of 0.15 or more.

In a conventional apparatus for manufacturing such a compressed lump of metal scrap, metal scrap, including ferrous metal scrap and nonferrous metal scrap, such as aluminum and copper, collected via various routes is sorted and compressed by a compression apparatus to form a compressed lump of metal scrap in the shape of a hexahedral body having a predetermined standard. A representative example of the apparatus for manufacturing the compressed lump of metal scrap is disclosed in Japanese Utility Model Publication No. S38-11798 entitled "Scrap press apparatus" (hereinafter, referred to as a 'cited invention').

The cited invention provides a scrap press apparatus configured to have a structure in which a slide type upper cover **1** is installed above a scrap molding chamber **2** having a press plate **5** and transverse press plates **20** provided at left and right sides thereof, a stationary cover unit **3** is installed above a material molding side of the scrap molding chamber **2**, a lower cover **7**, which can be freely opened and closed, to discharge a shaped product is installed under the material molding side of the scrap molding chamber **2**, a shearing cutter **4** is installed at a contact portion between the stationary cover unit **3** and the slide type cover, and a shearing cutter **6** is installed above the press plate **5**. In the cited invention, metal scrap is charged into the scrap molding chamber **2**, the upper cover **1** is closed, and a primary cylinder **14** is driven to advance a piston **13**. As a result, the press plate **5** primarily compresses metal scrap in the scrap molding chamber **2** into a form as indicated by a dotted line of FIG. **2**. Subsequently, the opposite transverse press plates **20** are advanced to the middle of the scrap molding chamber **2** by pistons **22** of cylinders **21** to secondarily compress the primarily compressed metal scrap. After the metal scrap is secondarily compressed, a lower cover actuating cylinder **8** connected to the lower side of the lower cover **7** is driven to pull the middle of a link **10**. As a result, the lower cover **7** is opened to the lower side, and therefore, a compressed lump **23** of metal scrap falls and is carried outside by a conveyor **18**.

A required number of compressed lumps of metal scrap of a predetermined standard manufactured according to the cited invention with the above-stated construction are directly introduced into a blast furnace to manufacture various kinds of steel products. Consequently, a very efficient operation is possible.

On the other hand, such a compressed lump of metal scrap is obtained by compressing a large amount of metal scrap with high density so that the volume of the compressed lump of metal scrap is small. For this reason, the compressed lump of metal scrap has large thermal capacity, and therefore, it is necessary to heat the compressed lump of metal scrap for a long time using a large amount of energy so as to melt the compressed lump of metal scrap. Consequently, a large amount of energy is consumed in a melting process with the result that costs necessary to manufacture steel products are greatly increased. Also, a discharge amount of carbon is increased as a large amount of energy is consumed with the result that environment is polluted.

As a rule, metal scrap must be sorted according to ingredients of the metal scrap so that pure nonferrous metal scrap or pure ferrous metal scrap can be separately compressed to manufacture such a compressed lump of metal scrap. However, some thoughtless processors mix concrete, which is heavy, with metal scrap to manufacture a poor compressed lump of metal scrap. If such a poor compressed lump of metal scrap is introduced into a blast furnace, the blast furnace is contaminated by impurities. Enormous expense is needed to remove contaminants from the blast furnace, and, in addition, a production project is frustrated. As a result, steelmakers have difficulty in using a compressed lump of metal scrap.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide an apparatus and method for forming a through hole in a compressed lump of metal scrap during manufacture of the compressed lump of metal scrap so that the compressed lump of metal scrap can be efficiently melted and the interior of the compressed lump of metal scrap can be observed instead of drilling a finished compressed lump of metal scrap to form a through hole in the compressed lump of metal scrap as in the cited invention, thereby efficiently producing the compressed lump of metal scrap.

In accordance with the present invention, the above and other objects can be accomplished by the provision of an apparatus for manufacturing a compressed lump of metal scrap, including a primary compression cylinder installed at one side of a compression chamber, a primary press plate

configured to be moved in a primary compression space by a piston of the primary compression cylinder, secondary compression cylinders installed at opposite sides of the compression chamber, secondary press plates configured to be moved in a secondary compression space by pistons of the respective secondary compression cylinders, a discharge plate disposed at the middle of the secondary compression space, and an opening and closing unit configured to open and close the discharge plate, wherein a direction in which compression is performed by the primary press plate is perpendicular to a direction in which compression is performed by the secondary press plate, and the apparatus further includes at least one core installed at the middle of the secondary compression space in an erected state so that the core is perpendicular to the direction in which compression is performed by the primary press plate and the direction in which compression is performed by the secondary press plate and a core cylinder for advancing and retreating the core to form at least one through hole, and a method of manufacturing a compressed lump of metal scrap using the apparatus for manufacturing the compressed lump of metal scrap.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a longitudinal sectional view showing the construction of a cited invention;

FIG. **2** is a plan view illustrating the construction of the cited invention;

FIGS. **3** and **4** are perspective views showing a compressed lump of metal scrap according to the present invention;

FIG. **5** is a perspective view showing overall construction of an apparatus for manufacturing a compressed lump of metal scrap according to the present invention when viewed from the rear of a cover;

FIG. **6** is a perspective view showing an operation standby state in a compression chamber of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **7** is a bottom view showing an installation state of a core cylinder of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **8** is a side view showing a state in which a core of the core cylinder is erected vertically before metal scrap is charged into the compression chamber of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **9** is a plan view showing a state in which charging of metal scrap into the compression chamber of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention shown in FIG. **8** has been completed;

FIG. **10** is a plan view showing a state in which a primary press plate has been advanced in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **11** is a plan view showing a state in which, after the primary press plate had been advanced, secondary press plates have been advanced to a secondary compression space by secondary compression cylinders in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **12** is a longitudinal sectional view showing a state in which a core is positioned in a through hole of the compressed lump of metal scrap after primary and secondary compression has been completed in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **13** is a plan view showing a state in which the compressed lump of metal scrap is dropped in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **14** is a side view showing a state in which the compressed lump of metal scrap is dropped and discharged from the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **15** is a perspective view showing an embodiment for forming two through holes in the compressed lump of metal scrap in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **16** is a longitudinal sectional view of a principal part of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention showing a state in which cores of the core cylinders are positioned in two through holes formed in a compressed lump of metal scrap as the result of primary and secondary compression;

FIG. **17** is a side view showing discharge of a compressed lump of metal scrap, two through holes of which have been formed by the cores of the core cylinders during primary and secondary compression;

FIG. **18** is a perspective view showing an embodiment in which a core cylinder is installed at a cover in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **19** is a longitudinal sectional view of a principal part of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention shown in FIG. **18** showing a state in which cores are positioned at portions of a compressed lump of metal scrap at which through holes are to be formed as the result of secondary compression performed by the secondary compression cylinders;

FIG. **20** is a side view showing discharge of metal scrap compressed according to the embodiment shown in FIG. **18** through a discharge port;

FIG. **21** is a perspective view showing another embodiment in which two core cylinders are installed at the cover in the apparatus for manufacturing the compressed lump of metal scrap according to the present invention;

FIG. **22** is a side sectional view of a principal part of the apparatus for manufacturing the compressed lump of metal scrap according to the present invention showing a state in which cores are positioned in through holes of the compressed lump of metal scrap after primary and secondary compression have been completed according to the embodiment shown in FIG. **21**; and

FIG. **23** is a side view showing discharge of a compressed lump of metal scrap, two through holes of which have been formed according to the embodiment shown in FIG. **21**.

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment of the present invention, there is provided an apparatus for manufacturing a compressed lump of metal scrap configured to compress metal scrap by a primary press plate reciprocated in a primary compression space of a compression chamber, which is opened and closed by a cover cylinder so that metal scrap is charged into the compression chamber, by a primary compression cylinder and secondary press plates reciprocated in opposite sides of a secondary

compression space of the compression chamber by secondary compression cylinders and to discharge the compressed lump of metal scrap through a discharge port, wherein a direction in which compression is performed by the primary press plate is perpendicular to a direction in which compression is performed by the secondary press plate, and the apparatus includes a core installed at the middle of the secondary compression space in an erected state so that the core is perpendicular to the direction in which compression is performed by the primary press plate and the direction in which compression is performed by the secondary press plate and a core cylinder for reciprocating the core.

Now, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings so that the present invention can be easily made by a person having ordinary skill in the art to which the present invention pertains.

First, a compressed lump **100** of metal scrap according to the present invention is shown in FIGS. **3** and **4**.

As shown in these drawings, the compressed lump **100** of metal scrap is formed into a hexahedral body having a predetermined width, length and height according to the present invention. At least one straight through hole **101** is formed in the compressed lump **100** of metal scrap so that the through hole **101** extends through the compressed lump **100** of metal scrap. When the compressed lump **100** of metal scrap is introduced into a blast furnace, therefore, hot air and molten metal can infiltrate into the compressed lump **100** of metal scrap through the through hole **101**. Consequently, it is possible to melt the compressed lump **100** of metal scrap using a small amount of fuel.

Also, it is possible for an engineer to inspect the interior of the compressed lump **100** of metal scrap through the through hole **101** with the naked eye or using a camera before the compressed lump **100** of metal scrap is introduced into the blast furnace.

As shown in FIG. **4**, it is possible to form two through holes **101**. According to circumstances, it is possible to form three or more through holes **101**, the diameter of which is small. The more through holes **101** the compressed lump **100** of metal scrap has, the easier the compressed lump **100** of metal scrap melts. However, it is necessary to additionally install a plurality of cores **201** and a plurality of core cylinders **200**, which are operated in a state in which metal scrap is compressed under high pressure. For this reason, it may be most economical to form only one through hole **101** in consideration of manufacturing equipment costs. Hereinafter, therefore, the present invention will be described based on embodiments of the present invention that form one through hole **101**.

FIGS. **5** and **6** are perspective views showing the concrete structure of a manufacturing apparatus according to the present invention when viewed in two directions. As shown in these drawings, the manufacturing apparatus according to the present invention includes two primary compression cylinders **110**, which are long. The primary compression cylinders **110** are provided to obtain force sufficient to primarily compress various forms of metal scrap, charged in a compression chamber **140**, during movement of a primary press plate **150** in a primary compression space **300** of the compression chamber **140** from one side of the compression chamber **140**. One, two or three primary compression cylinders **110** may be installed based on kinds and charge amount of metal scrap.

Also, secondary compression cylinders **120** are installed at opposite sides of a secondary compression space **400** of the compression chamber **140**. A secondary press plate **160** is fixed to a piston of each of the secondary compression cylinders **120** so that the secondary press plate **160** can be advanced toward the middle of the secondary compression space **400**.

Also, the movement distance of the secondary press plate **160** installed at each side of the compression chamber **140** is the distance by which the secondary press plate **160** moves to the compressed lump **100** of metal scrap formed at the middle of the secondary compression space **400**. Consequently, the stroke of the secondary press plate **160** is short, and therefore, the length of each secondary compression cylinder **120** and the length of the piston thereof are relatively short. Particularly, in the present invention, a core **201** configured to form a through hole **101** penetrating the middle of the compressed lump **100** of metal scrap and a core cylinder **200** to reciprocate the core **201** are installed in addition to the construction of the cited invention. The core **201** is installed perpendicularly to a primary press direction and a secondary press direction. At the same time, the core **201** is installed so as to be erected at the middle of the secondary compression space **400**. In the embodiment of the present invention shown in FIGS. **5** and **6**, the core cylinder **200**, which advances and retreats the core **201**, is installed under the middle of a discharge plate **502** as shown in FIG. **7**. A tip **170** having incline planes is formed at the front end of the core **201**. The tip **170** is engaged in a core tip receiving groove **130** of a cover **601** to prevent the core **201** from being deformed due to friction between the core **201** and the metal scrap or stress applied to the core **201**, which is caused by deviation of compression force applied to the metal scrap during primary and secondary compression.

Also, the manufacturing apparatus according to the present invention further includes the core **201** and the discharge plate **502** installed at the middle of the secondary compression space **400** as described above and an opening and closing unit **500** to open and close the discharge plate **502**.

The opening and closing unit **500** may include a hydraulic cylinder **504** and a piston in addition to the discharge plate **502**. The opening and closing unit **500** may be configured so that the discharge plate **502**, which is formed of a plate-shaped member having a thickness sufficient to bear pressure, is reciprocated along a guide groove **503** to open and close a discharge port **501**. Alternatively, the discharge plate **502** may be opened and closed by the hydraulic cylinder **504** so as to open and close the discharge port **501**.

In addition, in this embodiment of the present invention, the discharge plate **502**, the core cylinder **200** and the core **201** are simultaneously reciprocated by the hydraulic cylinder **504** since the core cylinder is installed at the middle of the bottom of the discharge plate **502**.

Also, in the present invention, the primary and secondary compression cylinders **110** and **120**, the core cylinder **200**, the hydraulic cylinder **504**, a cover cylinder **600** and a locking cylinder **602** are used. Although not shown, a hydraulic pipe is connected to the pistons so that the pistons can be advanced or retreated according to directions in which hydraulic pressure is supplied, which is well known in the art to which the present invention pertains, and therefore, a description thereof will be omitted for the sake of convenience. An operation standby state of the manufacturing apparatus according to the present invention is shown in a side view of FIG. **8**.

As shown in FIG. **8**, the core **201** is erected by the core cylinder **200** before charging of metal scrap, and the cover **601** is opened by the cover cylinder **600**. In this state, metal scrap is charged into the compression chamber **140**. After the primary compression space **300** and the secondary compression space **400** are filled with the metal scrap, the cover cylinder **600** is driven to close the cover **601**.

A state in which primary compression is ready as described above is shown in a plan view of FIG. **9**. As shown in FIG. **9**, the core **201** is advanced by the core cylinder **200**, the primary and secondary press plates **150** and **160** are located at the same position as walls of the compression chamber **140** in a state in which the primary and secondary compression cylinders **110** and **120** are in an operation standby mode, and the hydraulic cylinder **504** is in a state in which the discharge port **510** is closed by the discharge plate **502**.

In the manufacturing apparatus with the above-stated construction according to the present invention, first, the primary press plate **150** is moved to the end of the primary compression space **300** by the pistons of the primary compression cylinders **110** as shown in FIG. **10**. Consequently, metal scrap, which has been primarily compressed in the compression chamber **140**, is placed in the secondary compression space **400** in a standby state. The metal scrap wraps the corn **201** while moving to the secondary compression space **400** during primary compression. In this state, the tip **170** of the core positioned at the middle of the secondary compression space **400** is engaged in the core tip receiving groove **130** formed at the cover **601** according to the present invention, thereby preventing the core **201** from being pushed or deformed by the metal scrap moving to the secondary compression space **400** during primary compression.

Consequently, the metal scrap in the compression chamber **140** is clustered into the secondary compression space **400** while the density of the metal scrap is primarily increased by the primary press plate **150**, and the metal scrap clustered into the secondary compression space **400** is primarily compressed. At the same time, the core **201** is located at a portion of the compression chamber at which a through hole **101** is to be formed in a compressed lump of metal scrap. When the secondary press plates **160** start to compress the metal scrap in the secondary compression space **400** according to operation of the secondary compression cylinders **120** in a state in which the core **201** of the core cylinder **200** extends as described above, the metal scrap starts to be compressed at density higher than that of the primary compression as described above. When the secondary press plates **160** are advanced to a position corresponding to the final dimensions of a compressed lump **100** of metal scrap, the advancement of the secondary press plates **160** is stopped by the secondary compression cylinders **120**. This state is shown in a plan view of FIG. **11** and a side view of FIG. **12**. In this state, a through hole **101** is formed in the compressed lump **100** of metal scrap at the portion of the compression chamber at which the core **201** is located so that the through hole **201** surrounds the core **21** as shown in an enlarged sectional view of FIG. **12**.

In this state, however, the compressed lump **100** of metal scrap cannot be discharged. According to the present invention, therefore, it is necessary to retreat the core **201** so that the tip **170** of the core **201** is placed at a lower position than the surface of the discharge plate **502** and the compression chamber **140** as shown in FIGS. **13** and **14**.

To this end, the core cylinder **200** is driven. As a result, the core **201** is retreated, and then the primary compression cylinders **110** and the secondary compression cylinders **120** are retreated to their original positions. In addition, the hydraulic cylinder **504** of the opening and closing unit **500** is driven to reciprocate the discharge plate **502** along the guide groove **503** so that the discharge port **501** is opened with the result that the compressed lump **100** of metal scrap falls through the discharge port **501** and is carried outside by a conveyor.

Subsequently, the hydraulic cylinder **504** of the opening and closing unit **500** is driven to move the discharge plate **502** so that the discharge plate **502** closes the discharge port **501**. The core **201** is moved upward by the core cylinder **200**, and a piston **603** of the locking cylinder **602** is separated from a locking hole **604**, and then the cover cylinder **600** is driven to lift the cover **601** so that the manufacturing apparatus is in state as shown in FIG. **8**. Subsequently, metal scrap is charged into the compression chamber, the primary compression cylinders **110** are driven to resume primary compression with the respect to the metal scrap through the primary press plate **150**. In this way, the process of manufacturing the compressed lump **100** of metal scrap is continuously repeated.

In addition, according to the present invention, as shown in FIG. **15**, two core cylinders **200** are installed at the discharge plate **502** so that two cores **201** can be advanced and retreated, and tips **170** formed at the upper ends of the two cores **201** are configured to be engaged in two core tip receiving grooves **130** formed at the bottom of the cover **601**

In this state, metal scrap is charged into the compression chamber **140**, and primary and secondary compression is carried out through the process shown in FIGS. **9** to **11**. As a result, a compressed lump **100** of metal scrap is finally formed in a state in which two through holes **101** are formed in the compressed lump **100** of metal scrap at the portions of the compression chamber at which the two cores **201** are located at the middle of the secondary compression space **400** as shown in FIG. **16**. Subsequently, the hydraulic cylinder **504** of the opening and closing unit **500** is driven to retreat the discharge plate **502** along the guide groove **503** so that the discharge port **501** is opened. As a result, as shown in FIG. **17**, the compressed lump **100** of metal scrap falls and is discharged through the discharge port **501**.

Meanwhile, the core **201** and the core cylinder **200** may be installed at other positions different from the discharge plate **502**. A concrete example thereof is shown in FIG. **18**. As shown in FIG. **18**, the core **201** and the core cylinder **200** are installed at the cover **601** instead of the discharge plate **502**. In this embodiment, it is necessary to locate the core tip receiving groove **130** at the middle of the discharge plate **502**.

In this embodiment, as shown in FIG. **18**, the cover **601** is opened to open the compression chamber **140**. In this state, metal scrap is charged into the compression chamber **140**, the cover **601** is closed, and primary and secondary compression is carried out through the process shown in FIGS. **9** to **11**. In this embodiment, in order to easily achieve downward movement of the core **201** of the core cylinder **200** installed at the cover **610** moving downward to the secondary compression space **400** during charge of the metal scrap, it is necessary for the core **201**, which will form a through hole **101** in the compressed lump **100** of metal scrap, to be placed at a predetermined position before compression so that the metal scrap is not placed at the middle of the secondary compression space **400**.

In this embodiment, metal scrap is charged, the cover **601** is closed, and the core cylinder **200** is driven to move the core **201** downward. At this time, the tip **170** of the core **201** is engaged in the core tip receiving groove **130** formed at the middle of the discharge plate **502** with the result that the core **201** is stably fixed.

After location of the core **201** to form the through hole **101** in the compressed lump **100** of metal scrap has been completed as described above, primary and secondary compression is carried out through the above process to compress the metal scrap so that the metal scrap has a target density. As a result, the core **201** of the core cylinder **200** fixed to the cover **601** is located in the through hole **101** of the compressed lump **100** of metal scrap as shown in FIG. **19**.

In this state, the core cylinder **200** is driven to move the core **201** upward as shown in FIG. **20**. As a result, the core **201** is

separated from the through hole **101** of the compressed lump **100** of metal scrap. Subsequently, the hydraulic cylinder **504** of the opening and closing unit **500** is driven to reciprocate the discharge plate **502** along the guide groove **503** with the result that the discharge port **501** is opened.

Consequently, the compressed lump **100** of metal scrap, which is a weight body, falls and is discharged through the discharge port **501**.

In the above embodiment, the core **201** and the core cylinder **200** are installed at the cover **601** instead of the discharge plate **502**, and the core tip receiving groove **130** is formed at the discharge plate **502** as shown in FIG. **18**. In another embodiment, on the other hand, a plurality of cores **201** and a plurality of core cylinders **200** may be installed at the cover **601**, and a plurality of core tip receiving grooves **130** may be formed at the discharge plate **502**, as shown in FIG. **21**, to form a plurality of through holes **101** in the compressed lump **100** of metal scrap. That is, in this embodiment, the cover **601** is opened to open the compression chamber **140**, metal scrap is charged into the compression chamber **140**, the cover **601** is closed, and the core cylinders **200** are driven to move the cores **201** downward. At this time, the tips **170** of the respective cores **201** are engaged in the core tip receiving grooves **130** formed at the discharge plate **502** with the result that the cores **201** are stably fixed.

After location of the cores **201** to form the through holes **101** in the compressed lump **100** of metal scrap has been completed as described above, primary and secondary compression is carried out through the above process to compress the metal scrap so that the metal scrap has a target density. As a result, the through holes **101** are formed in the compressed lump **100** of metal scrap by the cores **201** of the core cylinders **200** fixed to the cover **601** as shown in FIG. **22**.

In this state, the core cylinders **200** are driven to move the cores **201** upward as shown in FIG. **23**. As a result, the cores **201** are separated from the through holes **101** of the compressed lump **100** of metal scrap. Subsequently, the hydraulic cylinder **504** of the opening and closing unit **500** is driven to reciprocate the discharge plate **502** along the guide groove **503** with the result that the discharge port **501** is opened. Consequently, the compressed lump **100** of metal scrap, which is a weight body, falls and is discharged through the discharge port **501**.

In the present invention as described above, the core **201** is located at the portion of the compression chamber at which the through hole **101** is to be formed in the compressed lump of metal scrap before the metal scrap is compressed under high pressure. Consequently, it is possible to form the through hole **101** in the compressed lump **100** of metal scrap, which is compressed with high density and thus cannot be processed except melting, while load is not applied to the core **201** and the relevant components.

In case of punching or drilling the compressed lump **100** of metal scrap using a drilling machine to form the through hole **101** in the compressed lump **100** of metal scrap, as can be commonly thought by those skilled in the art to which the present invention pertains, needs massive equipment, and high-priced materials for punching or drilling are frequently damaged or consumed.

In case of forming the through hole according to the present invention, on the other hand, the core is located at the portion of the compression chamber at which the through hole is to be formed in the compressed lump of metal scrap before the metal scrap is compressed under high pressure. Consequently, massive equipment is not needed, and high-priced materials for punching or drilling are not damaged or consumed, thereby greatly improving economy and operation efficiency.

Meanwhile, in the present invention, the discharge plate **502** is installed in the middle of the secondary compression space **400**, and the opening and closing unit **500** using the hydraulic cylinder **504** to reciprocate the discharge plate **502** is disposed under the discharge plate **502**. Of course, however, various kinds of well-known opening and closing devices may be selectively applied as needed.

Hereinafter, a method of manufacturing a compressed lump of metal scrap according to the present invention will be described with the accompanying drawings.

The method of manufacturing the compressed lump of metal scrap according to the present invention includes a step of charging metal scrap into the compression chamber **140**, a step of performing a locking operation to close the cover **601** using the cover cylinder **600** and to drive the locking cylinder **602** so that the piston **603** extends to be fitted into the locking hole **604**, a primary compression step of primarily compressing the metal scrap charged in the compression chamber **140** using the primary compression cylinders **110**, a secondary compression step of secondarily compressing the primarily compressed metal scrap using the secondary compression cylinders **120**, a discharge step of discharging a compressed lump **100** of metal scrap, compressed with target density through the secondary compression, through the discharge port, and a step of opening the cover **601** according to the operation of the cover cylinder **600** so that metal scrap can be charged into the compression chamber **140** again, the above steps being repeatedly carried out to repeatedly compress metal scrap, wherein the method of manufacturing the compressed lump of metal scrap according to the present invention further includes a space occupation step of vertically erecting the core **201** at the middle of the secondary compression space **400** so that the core **201** is located at a portion of the compression chamber at which a through hole is to be formed in the compressed lump of metal scrap before the primary compression step is carried out, a through hole forming step of maintaining the region of the secondary compression space occupied by the core **201** to form a through hole **101** in the compressed lump **100** of metal scrap while performing secondary compression using the secondary compression cylinders **120** after the primary compression is completed, and a core retreating step of separating the core **201** from the through hole to discharge the compressed lump **100** of metal scrap, compressed with target density, after the through hole **101** is formed in the compressed lump **100** of metal scrap.

Also, in realizing the method of manufacturing the compressed lump of metal scrap as described above, the core cylinder **200** to form the through hole **101** may be installed at the middle of the discharge plate **502**, which is opened and closed by the hydraulic cylinder **504** of the opening and closing unit **500** to open and close the discharge port **501**, as shown in FIGS. **5** to **14**. Hereinafter, a method of manufacturing a compressed lump of metal scrap through the above-stated construction will be described in more detail.

The method of manufacturing the compressed lump of metal scrap according to the present invention includes a step of charging metal scrap into the primary compression space **300** and the secondary compression space **400** of the compression chamber **140** and a step of performing a locking operation to close the cover **601** using the cover cylinder **600** and to drive the locking cylinder **602** so that the piston **603** extends to be fitted into the locking hole **604**, as shown in FIG. **9**, a primary compression step of primarily compressing the metal scrap charged in the compression chamber **140** using

the primary compression cylinders **110**, as shown in FIG. **10**, a secondary compression step of secondarily compressing the primarily compressed metal scrap using the secondary compression cylinders **120**, as shown in FIGS. **11** and **12**, and a discharge step of discharging a compressed lump of metal scrap, compressed with target density through the secondary compression, through the discharge port and a step of opening the cover according to an opening operation of the cover cylinder **600** so that metal scrap can be charged into the compression chamber **140** again, as shown in FIGS. **13** and **14**, the above steps being repeatedly carried out to repeatedly compress metal scrap, wherein the method of manufacturing the compressed lump of metal scrap according to the present invention further includes a space occupation step of upwardly extending the core **201** using the core cylinder **200** installed at the middle of the discharge plate **502** to close the discharge port **501** so that the core **201** is located at the middle of the secondary compression space **400** before the step of charging the metal scrap into the compression chamber **140** and the step of closing the cover **601** are carried out, an occupied space maintaining step of maintaining the middle of the secondary compression space occupied by the core **201** at the primary and secondary compression steps, a through hole forming step of maintaining the region of the secondary compression space occupied by the core **201** to form a through hole **101** in the compressed lump **100** of metal scrap after primary and secondary compression is completed, and a core retreating step of downwardly moving the core **201** to a position lower than the height of the discharge plate **502** using the core cylinder **200** so that the core **201** is separated from the compressed lump **100** of metal scrap to discharge the compressed lump **100** of metal scrap, compressed with target density, after the through hole **101** is formed in the compressed lump **100** of metal scrap. Also, a method of manufacturing the compressed lump of metal scrap according to another embodiment of the present invention may include a space occupation step of downwardly extending the core **201** using the core cylinder **200** so that the core **201** is located at the middle of the secondary compression space **400** before or after closing the cover **610** at which the core cylinder **200** is installed, an occupied space maintaining step of maintaining the middle of the secondary compression space occupied by the core **201** at the primary and secondary compression steps, a through hole forming step of maintaining the region of the secondary compression space occupied by the core **201** to form a through hole **101** in the compressed lump **100** of metal scrap after primary and secondary compression is completed, and a core retreating step of upwardly moving the core **201** to a position higher than the bottom of the cover **601** using the core cylinder **200** so that the core **201** is separated from the compressed lump **100** of metal scrap to discharge the compressed lump **100** of metal scrap, compressed with target density, after the through hole **101** is formed in the compressed lump **100** of metal scrap. Meanwhile, in the embodiment in which the core **201** is upwardly moved so that the core **201** can be placed at a higher position than the discharge plate **502** during the manufacturing process according to the present invention, the tip of the core **201** is fitted in the core tip receiving groove **130** formed at the bottom of the cover **601**, and in the embodiment in which the core **201** is downwardly moved so that the core **201** can be placed at a lower position than the cover **601** during the manufacturing process according to the present invention, the tip of the core **201** is fitted in the core tip receiving groove **130** formed at the middle of the discharge plate **502**. As a result, the core **201** is securely and stably fixed, and therefore, it is possible to efficiently bear friction between the core **201** and the metal scrap or stress applied to the core **201** during primary and secondary compression, thereby minimizing wear of the core or damage to the core.

Also, in the present invention, a plurality of through holes may be formed so that the compressed lump of metal scrap can be more easily melted when the compressed lump of metal scrap is introduced into a blast furnace. To this end, a plurality of core cylinders **200** may be installed at the discharge plate **502** as shown in FIGS. **15** to **17**, or a plurality of core cylinders **200** may be installed at the cover **601** as shown in FIGS. **21** to **23**. In each case, a plurality of core tip receiving grooves **130** is formed at the bottom of the cover **601** or the top of the discharge plate **502**.

Furthermore, in the present invention, well-known elements may be added or changed based on kinds of metal scrap or conditions of a manufacturing field where the apparatus for manufacturing the compressed lump of metal scrap is installed. Also, the technical characteristics of the present invention are not limited to the above-described embodiments and may be variously changed within the gist and concept intended by the present invention.

As apparent from the above description, a compressed lump of metal scrap manufactured according to the present invention has one or more through holes. When the compressed lump of metal scrap is introduced into a blast furnace, therefore, molten metal can infiltrate into the middle of the compressed lump of metal scrap through the through holes as well as the circumference of the compressed lump of metal scrap. Consequently, it is possible to rapidly melt the compressed lump of metal scrap at a speed equivalent to the speed at which a small-sized compressed lump of metal scrap is melted, thereby greatly reducing energy necessary to manufacture steel products.

Also, in the manufacturing apparatus according to the present invention, the metal scrap is primarily compressed around the core during the low-density compression process of primarily compressing the metal scrap charged in the compression chamber, and the metal scrap is secondarily compressed through the high-density compression process with the result that the through hole is formed in the compressed lump of metal scrap. Consequently, it is possible to minimize friction between the core and the metal scrap and stress applied to the core during the compression processes.

Particularly, in the present invention, the length of the core extending in the compression chamber to form the through hole in the compressed lump of metal scrap is configured to be equivalent to the length of the actual through hole of the compressed lump of metal scrap. Consequently, the length of the core is minimized, and therefore, bending stress applied to the core due to density deviation of the metal scrap during primary and secondary compression is minimized. Furthermore, since the length of the core is short, the deformation of the core is minimized, and therefore, durability of the core is greatly improved, thereby achieving stable operation of the core and increasing lifespan of the core.

In addition, in the present invention, metal scrap is charged into the compression chamber in a state in which the core is vertically erected in the compression chamber, and then primary and secondary compression is carried out. Consequently, the metal scrap is prevented from wedging into the core, the cover and the bottom of the compression chamber irrespective of shapes or kinds of the metal scrap, thereby achieving smooth operation.

What is claimed is:

1. An apparatus for manufacturing a compressed lump of metal scrap configured to compress metal scrap by a primary press plate reciprocated in a primary compression space of a

compression chamber, which is opened and closed by a cover and a cover cylinder so that metal scrap is charged into the compression chamber, by a primary compression cylinder and secondary press plates reciprocated in opposite sides of a secondary compression space of the compression chamber by secondary compression cylinders and to discharge the compressed lump of metal scrap through a discharge port, wherein the primary press plate and primary compression space and the secondary press plate and secondary compression space are vertically aligned such that, a direction in which compression is performed by the primary press plate is perpendicular to a direction in which compression is performed by the secondary press plate, and the apparatus comprises:

a core installed at the middle of the secondary compression space in an erected state so that the core is perpendicular to the direction in which compression is performed by the primary press plate and the direction in which compression is performed by the secondary press plate;

a core cylinder for reciprocating the core to form a through hole in a compressed lump of metal scrap, the core cylinder and the core are provided on a discharge plate; and

an opening and closing unit for reciprocating the discharge plate along a guide groove to open and close the discharge plate relative to the discharge port.

2. An apparatus for manufacturing a compressed lump of metal scrap configured to compress metal scrap by a primary press plate reciprocated in a primary compression space of a compression chamber, which is opened and closed by a cover and a cover cylinder so that metal scrap is charged into the compression chamber, by a primary compression cylinder and secondary press plates reciprocated in opposite sides of a secondary compression space of the compression chamber by secondary compression cylinders and to discharge the compressed lump of metal scrap through a discharge port, wherein a direction in which compression is performed by the primary press plate is perpendicular to a direction in which compression is performed by the secondary press plate such that the primary press plate and the secondary press plate are coplanar and the apparatus comprises:

a core installed at the middle of the secondary compression space in an erected state so that the core is perpendicular to the direction in which compression is performed by the primary press plate and the direction in which compression is performed by the secondary press plate;

a core cylinder and the core are provided on a discharge plate and the core cylinder is configured to reciprocate the core to form a through hole in a compressed lump of metal scrap, the core cylinder and the core are being installed at the bottom of the discharge plate so that the core can be retreated to a position lower than the height of the discharge plate or so that the core can be extended to a position equivalent to the height at which the core can come into contact with the bottom of the cover; and

an opening and closing unit for reciprocating the discharge plate to open and close the discharge plate relative to a discharge port.

3. An apparatus for manufacturing a compressed lump of metal scrap configured to compress metal scrap by a primary press plate reciprocated in a primary compression space of a compression chamber, which is opened and closed by a cover and a cover cylinder so that metal scrap is charged into the compression chamber, by a primary compression cylinder and secondary press plates reciprocated in opposite sides of a secondary compression space of the compression chamber by secondary compression cylinders and to discharge the compressed lump of metal scrap through a discharge port, wherein the primary press plate and primary compression space and the secondary press plate and secondary compression space are vertically aligned such that, a direction in which compression is performed by the primary press plate is perpendicular to a direction in which compression is performed by the secondary press plate, and the apparatus comprises:

a core installed at the middle of the secondary compression space in an erected state so that the core is perpendicular to the direction in which compression is performed by the primary press plate and the direction in which compression is performed by the secondary press plate;

a core cylinder provided on the cover for reciprocating the core to form a through hole in a compressed lump of metal scrap, the core cylinder and the core being installed at the cover so that the core can be retreated to a position higher than the bottom of the cover or so that the core can be downwardly extended to a position equivalent to the length at which the core can come into contact with a discharge plate; and

an opening and closing unit for reciprocating the discharge plate to open and close the discharge plate relative to the discharge port to permit removal of compressed metal.

4. The apparatus according to claim **1**, wherein the core has a tip, and a core tip receiving groove is formed at a corresponding surface coming into contact with the core when the core is extended.

5. The apparatus according to claim **2**, wherein a core tip receiving groove is formed at the bottom of the cover with which a tip of the core comes into contact.

6. The apparatus according to claim **3**, wherein a core tip receiving groove is formed at the discharge plate with which a tip of the core comes into contact.

7. The apparatus according to claim **5**, wherein the core comprises a plurality of cores, the core cylinder comprises a plurality of core cylinders, and the core tip receiving groove comprises a plurality of core tip receiving grooves.

8. The apparatus according to claim **6**, wherein the core comprises a plurality of cores, the core cylinder comprises a plurality of core cylinders, and the core tip receiving groove comprises a plurality of core tip receiving grooves.

9. The apparatus of claim **1**, wherein the core cylinder is installed on a bottom side of the discharge plate.

10. The apparatus of claim **9**, wherein the core cylinder is installed at a middle of the bottom side of the discharge plate.

11. The apparatus of claim **1**, wherein the opening and closing unit is driven to reciprocate the discharge plate along the guide groove.

12. The apparatus of claim **2**, wherein the core cylinder is installed on a bottom side of the discharge plate.

13. The apparatus of claim **12**, wherein the core cylinder is installed at a middle of the bottom side of the discharge plate.

14. The apparatus of claim **2**, wherein the opening and closing unit is driven to reciprocate the discharge plate along a guide groove.

15. The apparatus of claim **3**, wherein the core cylinder is installed on a top side of the cover.

16. The apparatus of claim **15**, wherein the core cylinder is installed at a middle of the a top side of the cover.

17. The apparatus of claim **3**, wherein the opening and closing unit is driven to reciprocate the discharge plate along a guide groove.

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